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(54) Video signal reproducing apparatus.

(57) M/N-fold high-speed reproduction is achieved in a video signal reproducing apparatus by displaying continued N frames at intervals of M frames. The order of the reproduced frames becomes 0, 1, 2, ..., N-1, M, M + 1, M + 2, ..., M + N - 1, 2M, 2M + 1, 2M + 2, ..., 2M + N - 1, 3M, 3M + 1, 3M + 2, ..., 3M + N - 1, ... In this way, good continuity of picture images between frames, when high-speed reproduction is performed in the video signal reproducing apparatus, can be provided.

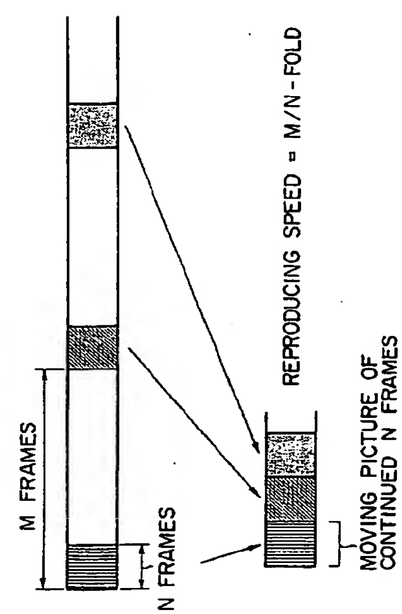

FIG. 1(a)

FIG. 1(b)

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way of illustrative and non-limiting example, with reference to the accompanying drawings, in which:

FIGs. 1(a) and 1(b) are drawings explanatory of basic operation of a system performing M/N-fold high-speed reproduction by reproducing continued N frames at intervals of M frames;

FIG. 2 is a block diagram of a structure of a video signal reproducing apparatus in which the invention is embodied;

FIG. 3 is a diagram showing an example of an operational timing chart in forward reproduction when the time for reading data equals the time for displaying the data;

FIG. 4 is a diagram showing an example of an operational timing chart in forward reproduction when the time for reading data is shorter than the time for displaying the data;

FIG. 5 is a diagram showing another example of an operational timing chart in forward reproduction when the time for reading data is shorter than the time for displaying the data;

FIG. 6 is a diagram showing an example of an operational timing chart in backward reproduction when the time for reading data equals the time for displaying the data;

FIG. 7 is a diagram showing an example of an operational timing chart in backward reproduction when the time for reading data is shorter than the time for displaying the data;

FIG. 8 is a diagram showing another example of an operational timing chart in backward reproduction when the time for reading data is shorter than the time for displaying the data;

FIGs. 9(a) and 9(b) are drawings explanatory of basic operation of a system performing M/L-fold high-speed reproduction by reproducing L frames within continued N frames at intervals of M frames;

FIG. 10 is an operational timing chart when L frames are reproduced in the reverse direction in a system performing M/L-fold high-speed reverse reproduction by reproducing L frames within continued N frames at intervals of M frames;

FIG. 11 is a diagram showing the order of reproduced frames when 20 frames at intervals of 1000 frames are reproduced in the forward direction in high speed;

FIGs. 12(a) and 12(b) are diagrams showing the orders of reproduced frames when 20 frames at intervals of 1000 frames and 10 frames at intervals of 1000 frames are reproduced in the forward direction in high speed, respectively;

FIGs. 13(a) and 13(b) are diagrams showing the orders of reproduced frames when 10 frames within 20 frames at intervals of 1000 frames and 20 frames within 40 frames at intervals of 1000 frames are reproduced in the forward direction in high speed, respectively;

FIGs. 14(a) and 14(b) are diagrams showing the basic operation of a previously proposed video disk system when A-fold high-speed reproduction is performed; and

FIGs. 15(a) and 15(b) are diagrams showing a high-speed reproducing operation in a previously proposed video disk system when the access period is longer.

An embodiment of the invention will be described in detail with reference to the accompanying drawings.

FIG. 2 is a block diagram showing a structure of a video signal reproducing apparatus in which the invention is embodied. Referring to FIG. 2, video data obtained by A/D converting a video signal and compressing the same for data on the MPEG system or the like is recorded. As an example of the related arts, there is one disclosed by us in US-A-5 155 593. A spindle motor 2 rotates the video disk 1 at a predetermined rotational speed. An optical head 3 throws a laser beam from a semiconductor laser incorporated therein on the video disk 1 and reads data recorded therein. The semiconductor laser in the optical head 3 is driven by a laser driver 4. The optical head 3 is structured to be slid in the radial direction of the video disk 1 by a slide motor 5.

A video signal reproduced from the optical head 3 is amplified by an RF amplifier 8 and supplied to a servo circuit 6 and an equalizer 9. The servo circuit 6 produces a tracking control signal, a focus control signal, and a spindle control signal from the output of the RF amplifier 8 and supplies the signals to the optical head 3 and the spindle motor 2. The servo circuit 6, further, supplies a control signal for controlling the slide motor 5 at the time of high-speed reproduction and random access.

The laser driver 4 and the servo circuit 6 are controlled by a system controller 7. The system controller 7 is formed of a microcomputer and executes control of the whole apparatus.

The equalizer 9 equalizes the output waveform of the RF amplifier 8 and supplies its output to a detector circuit 10 and a PLL circuit 11. The PLL circuit 11 extracts a clock signal on the basis of the output from the equalizer 9 and supplies the clock signal to the detector circuit 10. The detector circuit 10, on the basis of the clock signal, converts input data to binary data changing between two values of 0 and 1.

The output of the detector circuit 10 is supplied to a channel decoder 12 and, therein, demodulation of the modulated record is performed, and the output therefrom is supplied to an ECC decoder 13. The ECC decoder 13 performs error correction of the video data using an error correcting code added to the video data and outputs the corrected data to a RAM controller 14.

The RAM controller 14 temporarily stores the output of the ECC decoder 13 into a RAM 15 and reads

the reverse reproduction, two systems are possible: one in which the continued N frames are reproduced in the reverse direction and the other in which they are reproduced in the forward direction. The order of the displayed frames in each system is as follows:

In the system in which the continued N frames are displayed in the reverse direction: 3M + N - 1, 3M + N - 2, ..., 3M + 2, 3M + 1, 3M, 2M + N - 1, 2M + N - 2, ..., 2M + 2, 2M + 1, 2M, M + N - 1, M + N - 2, ..., M + 2, M + 1, M, N - 1, N - 2, ..., 2, 1, 0, ... In the system in which the continued N frames are displayed in the forward direction: 3M, 3M + 1, 3M + 2, ..., 3M + N - 1, 2M, 2M + 1, 2M + 2, ..., 2M + N - 1, M, M + 1, M + 2, ..., M + N - 1, 0, 1, 2, ..., N-1, ...

The same as in the case of the forward reproduction, relationships among the operation to read data, the operation to access the track, and the operation to display data will be described below.

(a) In the case where Data Read Time = Data Display Time

In this case, reading and displaying of video data are performed at the timing shown in FIG. 6. More specifically, data is read at intervals of one frame and, when reading of one frame is finished, the optical head 3 is caused to move to the track where the data to be read next is recorded so that it can read the data. This access period must be within the vertical blanking period. This is an example of the system in which the continued N frames are reproduced in the reverse direction. Such reading and displaying can be achieved only when the video data is not compressed or the compression system is that performed within the frame. When motion compensated coding is performed as in the MPEG system, decoding in the reverse direction is impossible and, hence, such reproduction in the reverse direction of continued N frames cannot be achieved.

In the case where Data Read Time = Data Display Time, reproduction of continued N frames in the forward direction is also possible.

(b) In the case where Data Read Time < Data Display Time

FIG. 7 shows an example of the system in which continued N frames are reproduced in the reverse direction. In this example, the data necessary for displaying N frames are read from the video disk 1 in the forward direction and, when the reading of the N frames has been finished, the track where data to be read next is present is accessed. The data read are decoded by the source decoder 16 and written into the frame memory 18. When writing of N-frame data has been finished, the data are read in the order reverse to the order in which the data were written and output to the display unit.

In this case, though the frame memory 18 is required to have N-frame capacity, video data are input to the source decoder 16 in the forward direction. Therefore, even if the data compressing system is such as the MPEG system in which motion compensation is made, this method can be achieved. Although the time for reading necessary data for displaying N frames and the time for writing the data into the frame memory 18 is equal in the case of FIG. 7, this can be attained by increasing the speed of the write clock of the frame memory controller 17.

FIG. 8 is an example of the system in which continued N frames are reproduced in the forward direction. In this example, N frames of data are read in the forward direction and, when the reading has been finished, the operation to access the track where the data to be read next is recorded is performed the same as in FIG. 7. In this case, however, the video data decoded by the source decoder 16 are not stored in the frame memory 18 for reversing the order but they are output to the display unit as they are.

In this case, the time interval between each of the N-frame data becomes larger as the value of M is increased. Therefore, a reproduced image not looking strange can be obtained even if the continued N frames are not reproduced in the reverse order. Further, it is possible to eliminate the frame memory 18.

[3] System in which part of continued N frames at intervals of M frames are reproduced

FIGs. 9(a) and 9(b) are diagrams explanatory of the basic operation in the system in which L frames within continued N frames at intervals of M frames are reproduced and, thereby, M/L-fold high-speed reproduction is achieved. In the above, M, N, and L are integers satisfying M > N > L > 1. It is necessary that the L frames are split into at least two portions within the N frames as shown in FIG. 9(b). An example of the order of frames reproduced in the forward direction when L = N/3 becomes as follows:

0, 3, 6, ..., N - 1, M, M + 3, M + 6, ..., M + N - 1, 2M, 2M + 3, 2M + 6, ..., 2M + N - 1, 3M, 3M + 3, 3M + 6, ..., 3M + N - 1, ...

Thus, in this reproducing system, when reading of data necessary for displaying a frame is finished, the track located N/L frames rearward where the data to be read next is recorded is accessed. Otherwise, N-frame data may be read in succession and only necessary portion thereof may be decoded and displayed. In the case of reverse reproduction, two systems are applicable as in the case described in [2](b), i.e., one system in which L frames are reproduced in the forward direction and the other system in which the L frames are reproduced in the reverse direction. Operation performed in the system in which reproduction is made in the reverse direction is shown in FIG. 10. In this case, only L-frame capacity is re-

N frames or N fields at intervals of M frames or M fields (where M and N are integers satisfying M > N > 1) to display means.

5. A video signal reproducing apparatus according to claim 4, wherein, when high-speed reverse reproduction is performed thereby, N frames or N fields of a video signal are read in the forward direction and the read video signal is output to said display means in the forward direction.

6. A video signal reproducing apparatus according to claim 5, wherein said video signal is recorded in said disk-shaped storage medium on the MPEG system.

7. A video signal reproducing apparatus according to claim 6, wherein said disk type storage means is an optical disk.

F I G. 2

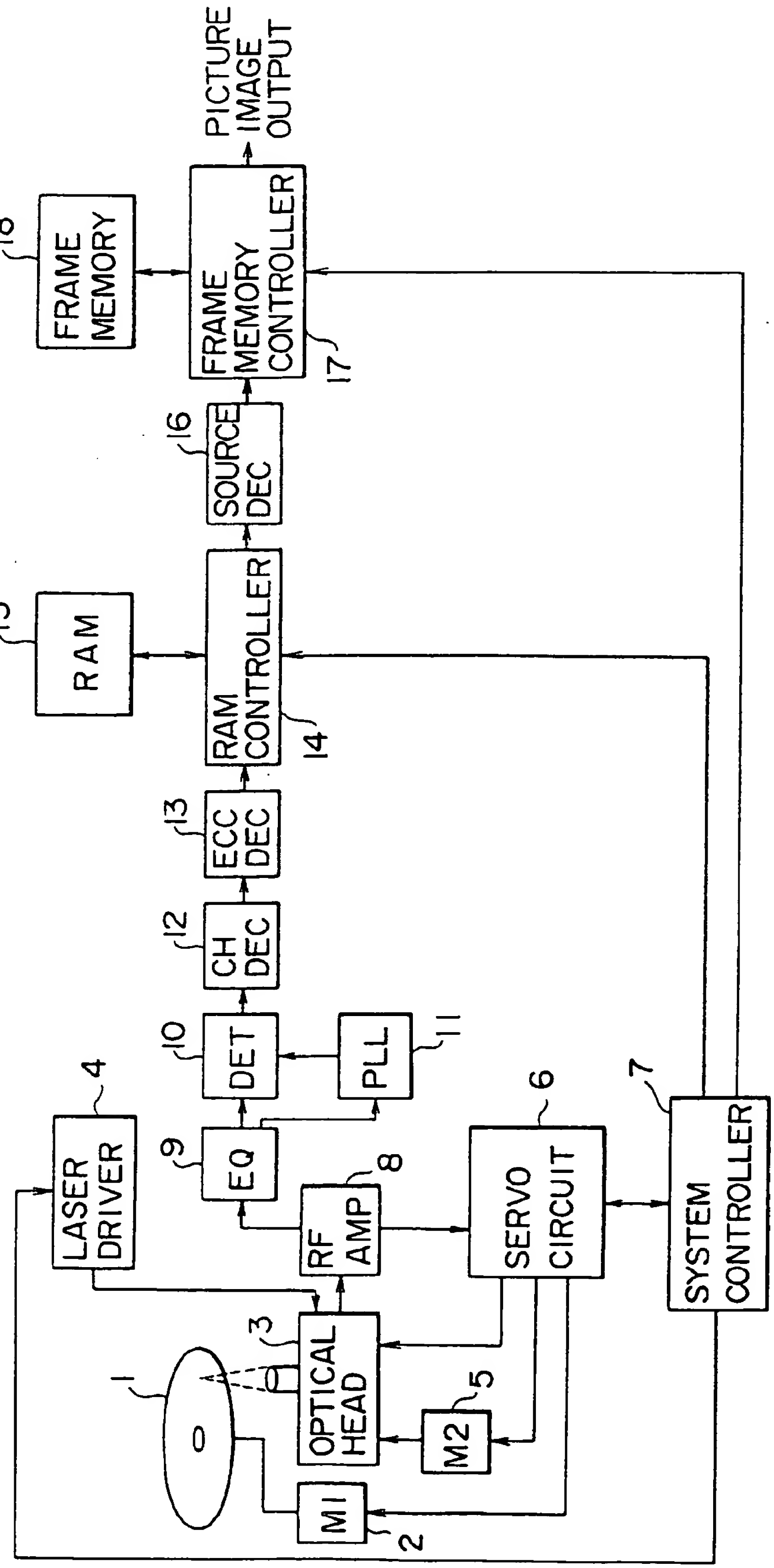

PICTURE IMAGE OUTPUT
18
FRAME MEMORY
FRAME MEMORY CONTROLLER
17
16
SOURCE DEC
15
RAM
RAM CONTROLLER
14
13
ECC DEC
12
CH DEC
10
DET
PLL
11
4
LASER DRIVER
9
EQ
8
RF AMP
6
SERVO CIRCUIT
7
SYSTEM CONTROLLER
3
OPTICAL HEAD
1
5
M2
M1
2

FIG. 5

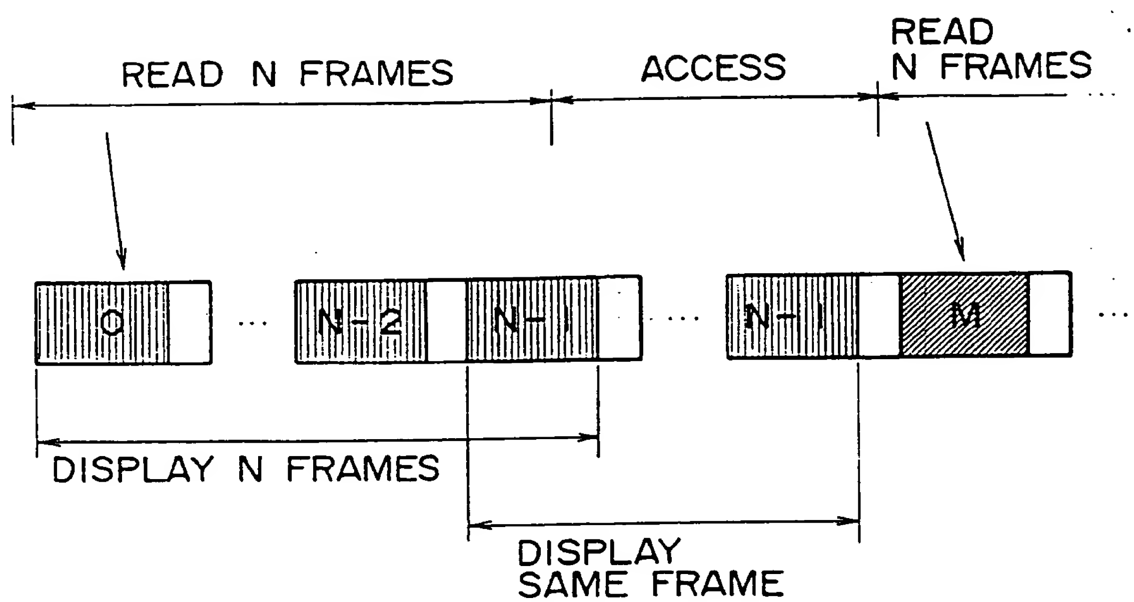

READ N FRAMES
ACCESS
READ
N FRAMES
0
N-2
N-1
N-1
M
DISPLAY N FRAMES
DISPLAY
SAME FRAME

FIG. 6

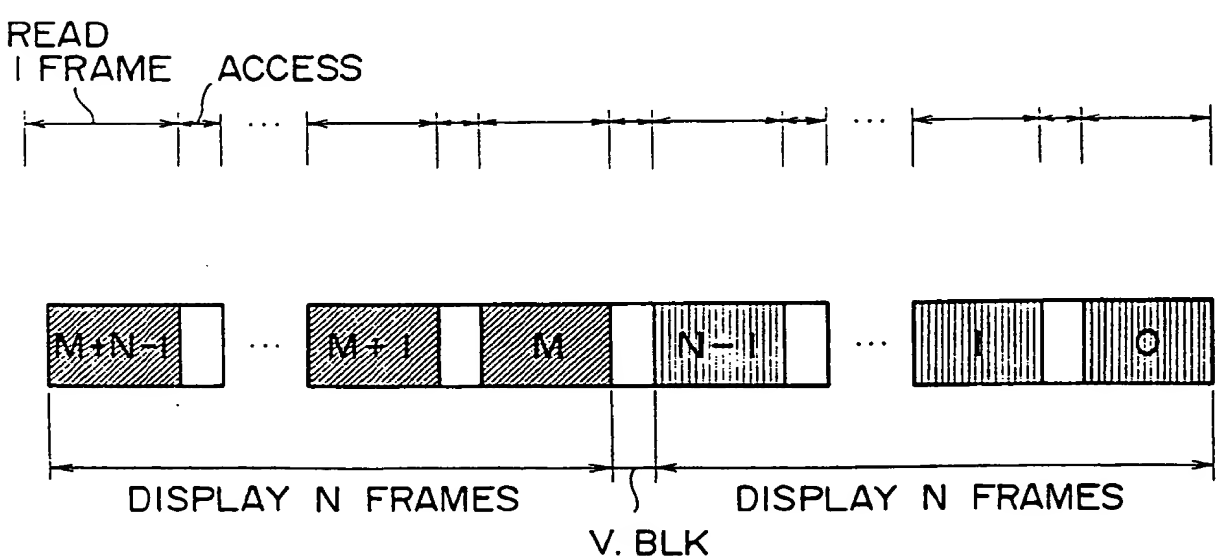

READ
1 FRAME
ACCESS
M+N-1
M+1
M
N-1
1
0
DISPLAY N FRAMES
DISPLAY N FRAMES
V. BLK

FIG. 8

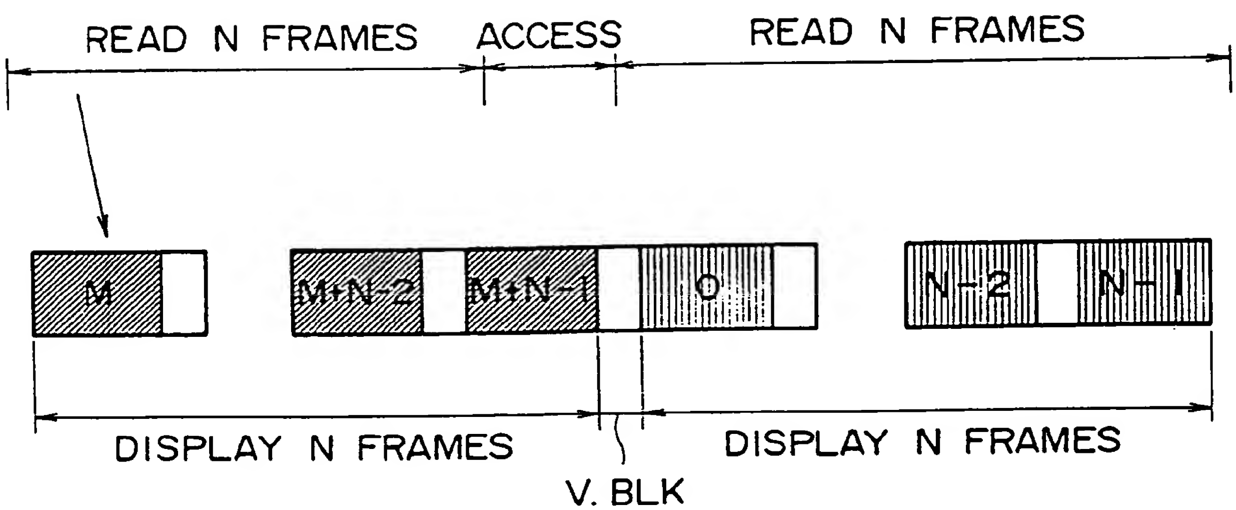

READ N FRAMES
ACCESS
READ N FRAMES
M
M+N-2
M+N-1
0
N-2
N-1
DISPLAY N FRAMES
DISPLAY N FRAMES
V. BLK

FIG. 10

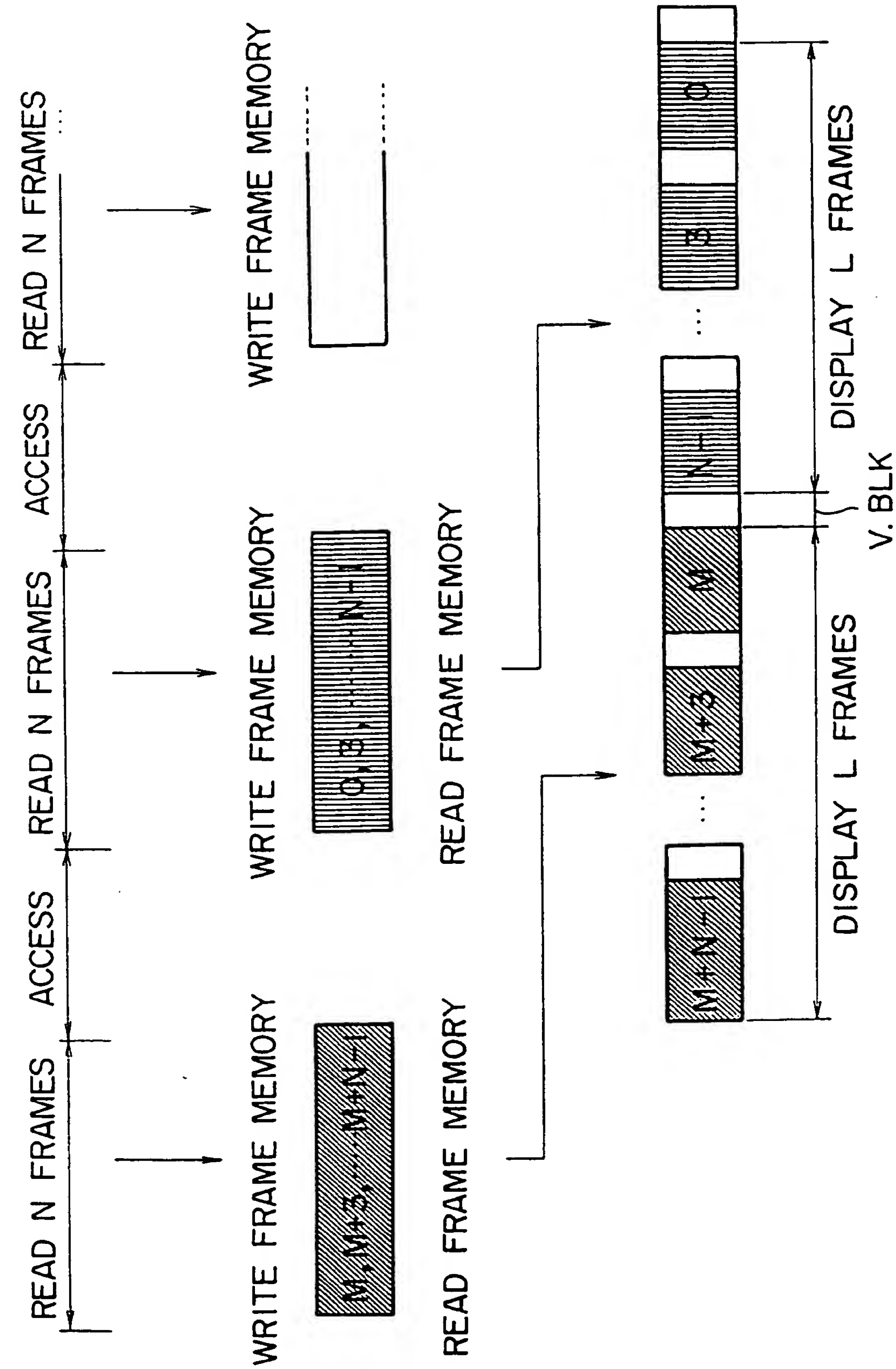

READ N FRAMES
ACCESS
READ N FRAMES
ACCESS
READ N FRAMES
WRITE FRAME MEMORY
M, M+3, ··· M+N-1
WRITE FRAME MEMORY
0, 3, ······ N-1
WRITE FRAME MEMORY
READ FRAME MEMORY
READ FRAME MEMORY
M+N-1
M+3
M
N-1
3
0
DISPLAY L FRAMES
DISPLAY L FRAMES
V. BLK

FIG. 12(a)

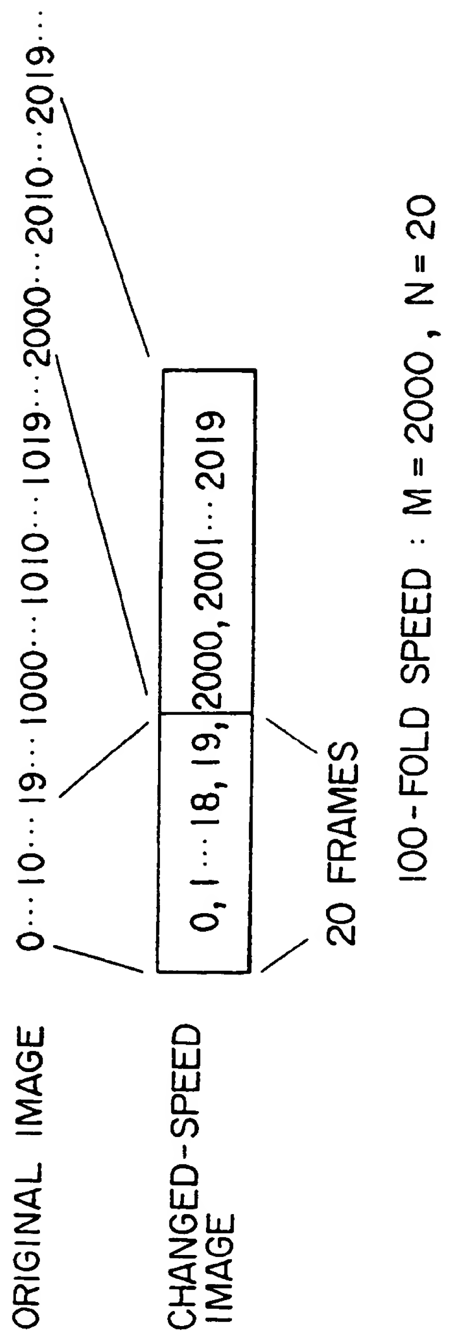
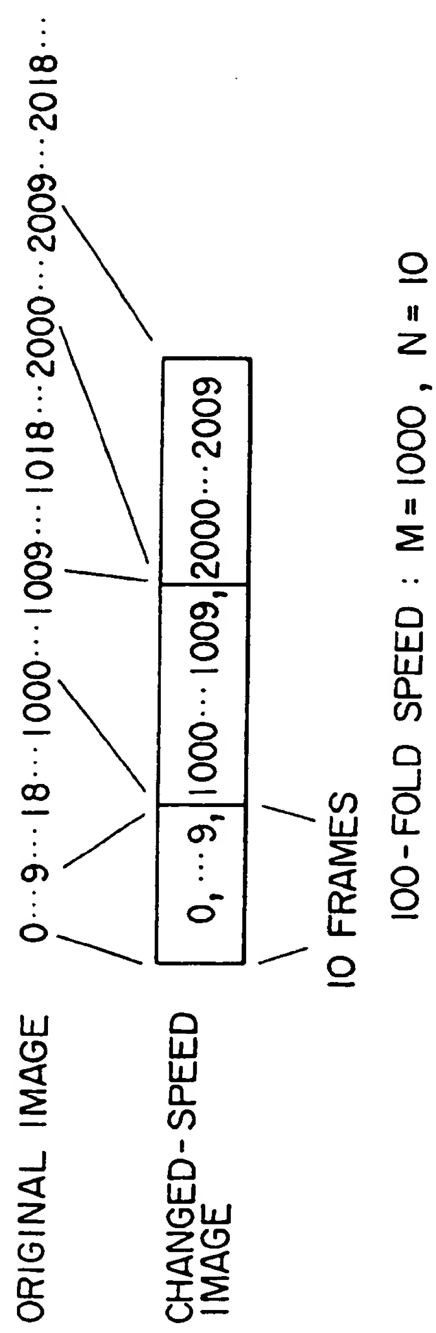


FIG. 12(b)



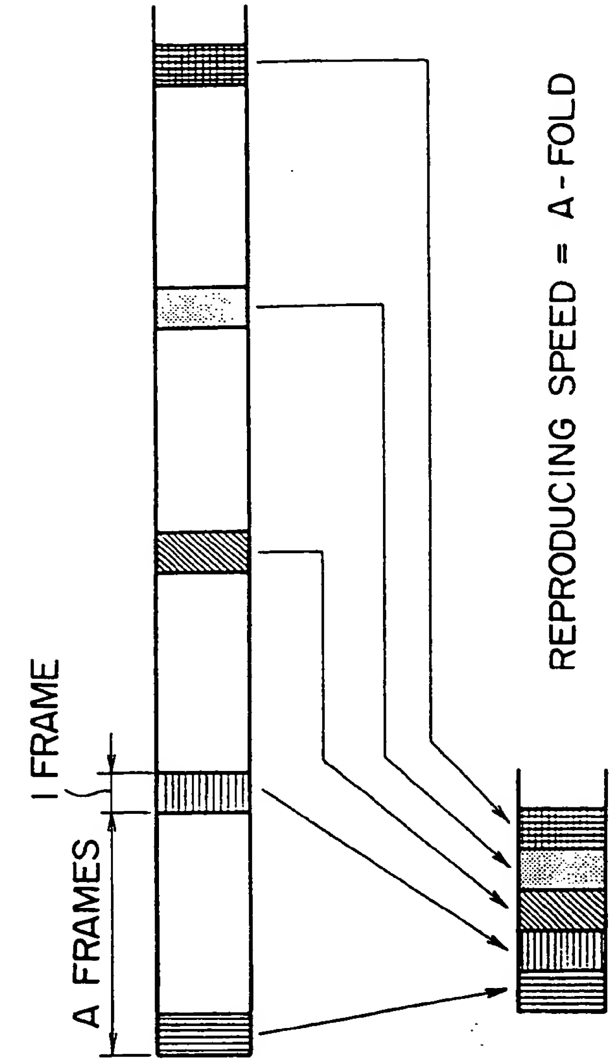


FIG. 14(a)

FIG. 14(b)

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(54) **Video signal reproducing apparatus**

(57) M/N-fold high-speed reproduction is achieved in a video signal reproducing apparatus by displaying continued N frames at intervals of M frames. The order of the reproduced frames becomes 0, 1, 2, ..., N-1, M, M + 1, M + 2, ..., M + N - 1, 2M, 2M + 1, 2M + 2, ..., 2M + N - 1, 3M, 3M + 1, 3M + 2, ..., 3M + N - 1, ... In this way, good continuity of picture images between frames, when high-speed reproduction is performed in the video signal reproducing apparatus, can be provided.

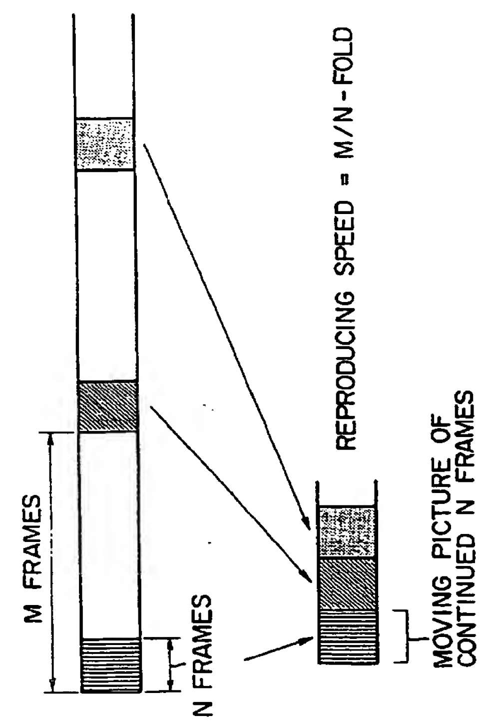

FIG. 1(a)
FIG. 1(b)

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